Direct Instruction Revisited: A Key Model for Instructional Technology

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Rooted in behavioral theory, particularly the radical or selectivist behaviorism of B.F. Skinner (1953, 1954, 1966, 1968, 1974), the direct instruction (DI) approach to teaching is now well into its third decade of influencing curriculum, instruction, and research. It is also in its third decade of controversy. Our purpose is to present the DI model with the notion that the designer can and should use the model effectively based on appropriate assessment of the learners, content, context, and task at hand. To accomplish our goal, we begin with a general discussion of the basic DI framework, followed by a summary of the major DI models that have been used in live instructional contexts. We then shift to a review of how DI has been used in technology-based learning environments. Finally, we conclude with a look into the future of DI.

☐ Rooted in behavioral theory, particularly what Skinner labeled the radical or selectionist behaviorism (see, e.g., Skinner, 1953, 1966), the direct instruction (DI) of Siegfried Engelmann (Bereiter & Engelmann, 1966) is now well into its third decade of influencing curriculum, instruction, and research. It is also in its third decade of controversy (c.f., Gersten, Baker, Pugach, Scanlon, & Chard, 2001).

To begin, we offer a definition and our stance related to DI—which has become the whipping post in some pedagogical camps, while the panacea in others. For clarity, DI is *not* a lecture approach (e.g., Freiberg & Driscoll, 2000). It *is* an instructional model that focuses on the interaction between teachers and students. Key components of DI include "modeling, reinforcement, feedback, and successive approximations" (Joyce, Weil, & Calhoun, 2000, p. 337). Joyce and colleagues specified the instructional design principles, which include the framing of learner performance into goals and tasks, breaking these tasks into smaller component tasks, designing training activities for mastery, and arranging the learning events into sequences that promote transfer and achievement of prerequisite learning before moving to more advance learning. Essentially, DI is "modeling with reinforced guided performance" (Joyce et al., p. 337).

Our intent in this article is to explicate the genesis, components, and permutations of DI as it has evolved in practice, and describe how it is being used in instructional technology. Three purposes undergird this article. (a) First, we believe that DI is a viable, time-tested instructional model that plays an important role in a

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comprehensive educational program. The research indicates its usefulness in maintaining time on task, the learning of skilled performance, and high rates of success when designed correctly (e.g., Fisher et al., 1980; Slavin, Madden, Dolan, & Wasik, 1996). Therefore, we believe that instructional designers, software designers, teachers and the like ought to know its foundation, essential components, historical and current uses, and potential for designing instruction that promotes student success for particular instructional objectives. (b) Second, and related to the first, our experience with lay faculty (and some instructional technology practitioners) who design instruction, especially online education, indicates a dearth of knowledge regarding the research and application of DI. Over the past two decades, DI has been overused by some, maligned by others, and frequently been wrongly equated with a pure lecture approach. DI is not for all uses, objectives, or learners; no approach is. DI is a useful tool for the appropriate purpose, objectives, and context, and the appropriate learners. (c) Finally, while DI has maintained its core principles over time, it has evolved in response to new understandings about learners and learning. We will elaborate on these variations (e.g., expository teaching) and the research that indicates their utility.

The DI model was created by Engelmann and his colleagues in the 1960s at the University of Illinois at Champagne-Urbana under a Project Follow Through grant. The research first appeared in 1966 (Bereiter & Engelmann). Science Research Associates published the first implementation of the model known as Direct Instruction System for Teaching And Remediation (DISTAR), programs that addressed beginning reading, language, and math (Engelmann & Bruner, 1969; Engelmann & Carnine, 1969; Engelmann & Osborn, 1969). Few models have been as researched as DI, including the largest educational evaluation ever conducted comparing it with 12 other models, across nearly 30 years, and involving nearly 75,000 students at 180 sites. In that large evaluation (Bock, Stebbins, & Proper, 1977; Watkins, 1997), as in numerous studies (e.g., Madaus, Airasian, & Kellaghan, 1980; Rosenshine, 1970, 1971, 1985), DI was found to be effective and superior to other models in everything from learning engagement to achievement to student affect.

As a selectionist model, DI is underpinned by the basic notion that behavior, like physical characteristics, evolves or is selected by the environment. Those behaviors that work are selected by the consequences that follow the behavior. Since there are different consequences for the same behavior in different environments, behaviors are situated in contexts. (It is important to note however that the *cause* of a behavior is not the context but rather the consequence, in the same sense that high leaves do not cause a giraffe's neck to grow. Rather the consequence of longer neck mutations is to be able to eat leaves that few other animals can reach.)

Further, in behavioral-based models such as DI, it is assumed that learners must be active (behaving) to learn. In *The Technology of Teaching*, Skinner (1968) stated,

> It is important to emphasize that a student does not passively absorb knowledge from the world around him but must play an active role, and also that action is not simply talking. To know is to act effectively, both verbally and nonverbally. (p. 5)

Moreover, in such models it is assumed that learning is universal, in the sense that the same selectionist principles are involved in learning from planeria to people; from shoe tying to tying off the last suture in brain surgery (and everything in between). Selectionists might agree that what we call higher level or higher order activities may separate us from the rest of the animal kingdom, but they believe that the way we learn such things does not.

Further, behaviorally based models reject logical positivism, mentalisms such as mind (although not mental activity), and free will. As might be expected, rejection of such concepts causes passionate reactions even today. For example, an editorial in *Early Childhood Education Journal* (Jalongo, 1999) reported the author's (and her classmate's) first reaction to a movie that showed the DI curriculum, DISTAR, as a "harsh, inflexible, and depersonalizing approach" (p. 139) that she worried could resurface today. She said that she would "like to see a stake driven in the heart of DISTAR" (p. 139). Yet, in the same editorial Jalongo conceded that DI "does have a place"—that "it is the method of choice for low-level tasks such as learning to cut with scissors or tying shoes" (p. 139). She also saw it as useful for special needs children.

The issue, then, is not whether selection accounts for at least some behaviors or whether behavioral approaches work with humans, the issue is whether some other type of learning evolved and "kicks in" that is unique to some higher level behavior in humans. Indeed although many critics would argue against DI as a model for higher level learning or performance, the model does work well in situations where motor skills or prerequisite intellectual skills are involved (e.g., Gagné, 1985). Such prerequisite skills might include learning such things as "mathematical procedures, grammatical rules, the states of New England, alphabetizing, carburetor overhaul, scientific equations, and the periodic table of elements to name a few" (Gunter, Estes, & Schwab, 1999, p. 79). Moreover, as Gunter et al. put it, "every teacher, in every subject, at every level of schooling has some learning objectives related to basic skills that must be mastered before the learner can move to other levels of thinking and learning" (p. 79).

In fact, DI has re-emerged in recent years as a viable instructional strategy that can be situated successfully within a range of tools that promote a range of types of learning within contemporary learner-centered pedagogy (e.g., Eggen & Kauchak, 2001; Gersten et al., 2001; Schwartz & Bransford, 1998; Tharp & Gallimore, 1988). For example, Schwartz and Bransford reported their research that illustrates that there is a "time for telling" within a problem-based learning approach. Gersten and colleagues described how recent theoretical frameworks have helped to elaborate the conceptualization of DI, and offered examples of contemporary DI research that focus on the learning of explicit strategies, concepts, and higher order thinking skills. Tharp and Gallimore situated DI within a range of strategies that comprise their "teaching as assisted performance" model. Eggen and Kauchak asserted that "the model can also be used to teach other forms of content such as generalizations, principles and academic rules" (p. 287).

Nowhere is DI more evident than in computer-mediated learning environments. From computer-aided instruction to distance learning experiences, the basic tenets of DI are infused—with greater and lesser fidelity. And, although DI is no longer the most prominent instructional framework for the overall design of computer-mediated applications (c.f., Cognition and Technology Group at Vanderbilt, 1996), DI is the strategy of choice when the learning objective requires that the learners have direct practice in what must be done, or said, or written (Cazden, 1992).

Consequently, our purpose here is not to promote DI as the *only* instructional framework to promote learning, either in live or computer-mediated learning environments. Our purpose is to present the DI model along with the notion that the designer can and should use the model effectively based on appropriate assessment of the learners, content, context, and task at hand (Shambaugh & Magliaro, 1997). To accomplish our goal, we begin with a general discussion of the basic DI framework, followed by a historical trace of exemplar DI models that have been studied and used in live instructional contexts over the past 30 years. We then shift to a review of how DI has been used in technology-based learning environments. Finally, we conclude with a look into the future of DI.

DI: HISTORY, CONCEPTS, AND MODELS

DI has been used to describe a range of instructional models used in face-to-face learning contexts—all designed to promote on-task student behavior by the teacher's effort to monitor and control student classroom attention and persistence (Corno & Snow, 1986). The various models have emerged from primarily behavioral traditions; however, over time the models have reflected the prevailing theoretical orientation to and interpretation of teacher-directed actions in a classroom. Moreover, these models may not be entitled DI per se, but share key components (e.g., Tobias, 1982) that translate very well into design features of live, as well as technology-enhanced or technology-driven, instruction. These components are:

1. Materials and curriculum are broken down into small steps and arrayed in what is assumed to be the prerequisite order.
2. Objectives must be stated clearly and in terms of learner outcomes or performance.
3. Learners are provided with opportunities to connect their new knowledge with what they already know.
4. Learners are given practice with each step or combination of steps.
5. Learners experience additional opportunities to practice that promote increasing responsibility and independence (guided and/or independent; in groups and/or alone).
6. Feedback is provided after each practice opportunity or set of practice opportunities.

The fundamental design principle that connects these components is the fact that learners are actively engaged in the relevant curriculum in order to build knowledge, skills, and dispositions related to the goals and objectives of the lesson. This frequent opportunity-to-respond enables ongoing assessment and correction when needed (Delquadri & Greenwood, 1981). The clear goal of this model is that learners will develop mastery and automaticity of the target skills, knowledge, and dispositions.

A number of empirically supported DI models have appeared in the literature in the last four decades. Our historical tour through some of the major models describes the nuances of each model and illustrates the richness of DI as a useful instructional strategy across a range of learning environments. The order of model presentation also reveals a bit of the evolution of DI that was prompted by the ongoing research on learning and instruction. We begin with the work of Bereiter and Engelmann (1966). These researchers are often credited with pioneering the research on DI, which, at that time, was based on principles of behavioral psychology including overt responding, frequent and specific feedback, and contingency management. The next stop in the tour is with exemplar models developed from the effective teaching research (e.g., Brophy & Good, 1986), which began to merge the well-established theoretical concepts from behavioral psychology with the newly instantiated principles based on the research using the information processing model of human memory. These models, based in process-product research, served as the foundation of thousands of studies relating teacher behavior and student achievement in the 1970s and 1980s (e.g., Anderson, Evertson, & Brophy, 1979), and continue to current practice with Slavin's "Success for All" program (Slavin et al., 1996). Next, we address the work of Robert Gagné (1977, 1985), whose development of events of instruction clearly situated teacher-led models into cognitive psychology and the instructional design literature. We close this section with a discussion of variations on the DI model that includes expository instruction (Jacobsen, Eggen, & Kauchak, 1993) and teaching-as-assisted-performance (Tharp & Gallimore, 1988). These variations represent important examples of the evolution of the DI model—ones that appropriately advance the model in light of new understandings of how people learn and how to design learning environments that meet stated learning objectives.

Behaviorally Based Models

Bereiter and Engelmann (1966) and Engelmann (1980) designed their DI approach to be "the most efficient way to teach each skill" (Engelmann, p. xi). The premise was that learners are expected to derive learning that is consistent with the presentation offered by the teacher. Learners acquire information through choice-response discriminations, production-response discriminations, and sentence-relationship discriminations. The key activity is for the teacher to identify the type of discrimination required in a particular task, and design a specific sequence to teach the discrimination so that only the teacher's interpretation of the information is possible. Rapid questioning, frequent testing, continuous interaction, and positive reinforcement are all key instructional tools that promote learning. The perspective of Bereiter and Engelmann was that DI is sufficiently broad in interpretation to serve as a teaching approach that has an unlimited number of applications. Over the course of 15-plus years, Engelmann's DI model framed such successful programs as

DISTAR (e.g., Engelmann & Osborn, 1972), Project Follow Through (Nero & Associates, 1975; Stallings & Stipek, 1986), and the Tucson early education model (Rentfrow, 1972).

The initial DI model (Bereiter & Engelmann, 1966) established a three-stage, systematic teaching design driven by continuous assessment of learning. The general process included (a) an introduction to the new content to be learned, (b) the main presentation of the lesson, and (c) practice with immediate feedback. At first, practice would be teacher directed, with the entire class responding to quickly paced, strategically sequenced questions from the instructor. Once the teacher was certain that the students were ready to apply the newly learned concepts, the students were shifted to independent practice, closely monitored by the teacher to ensure only correct interpretations and applications of the targeted content. This approach—introduction of new concepts, interactive presentation and application of the concepts, and guided practice—would serve as a standard for future variations on the DI model. Table 1 compares the models, highlighting the consistency of instructional procedure and distinguishing features.

Engelmann's (1980) DI model "attempts to control every variable in the teaching environment" (p. 80) through scripted tasks and lessons. This releases the teacher to focus on:

- The presentation and communication of the information to children.
- Students' prerequisite skills and capabilities to have success with the target task.
- Potential problems identified in the task analysis.
- How children learn, by pinpointing learner successes and strategies for success attainment.
- Learning how to construct well-designed tasks.

The students would increase their self-esteem and self-confidence through their academic achievement, providing motivation for subsequent tasks. Berieter and Engelmann's (1966) research made important contributions to educational research by illustrating how students from disadvantaged homes were able to increase language and school success through an increased opportunity to respond. In essence, the students succeeded because of the high rate of feedback and subsequent responding. Essentially, the idea was that "success breeds success" (Stallings & Stipek, 1986).

The data-driven nature of the DI model, with frequent opportunities for student response and teacher feedback, reflects the integration of continuous assessment throughout this design. Behavioral assessments of learning focus on the collection of data related to learning outcomes (Schunk, 2000), that is, how the learner's behavior changes as a result of the instruction. DI lessons rely on several inherent approaches to data collection in order for the teacher to monitor student learning. Oral responses in group-based interactions provide the instructor with information related to how well students are grasping the targeted content, as well as correcting any misconceptions so that only accurate interpretations of the new concept are taught. Written performances and direct observations allow the teacher to gauge progress and assess the learner's ability to apply the newly acquired concepts during independent practice. Such emphasis on continuous assessment suggests that DI may have been one of the first teaching models to incorporate data-based decision making, as the teacher based choices related to presentation strategies, timing, examples, and practice readiness on student response data.

Engelmann (1980) acknowledged two potential problems with this model: external attributions for success, and the need to experience the model for at least one year in order to accrue long-term benefits.

The "Effective Teaching" DI Models.

During the 1970s and through the mid-1980s, a number of variations and elaborations of Engelmann's (1980) model were designed and tested using a process-product paradigm and characterized in the well-known effective teaching literature. The general teaching procedure across these models was to begin with some type of opening activity, next to enact the main lesson presentation, and then to give students opportunities for practice. Three specific models reported high success rates and were widely

Table 1 ☐ Comparison of components across three Effective Teaching models.

Basic Direct Instruction	*Engelmann's Direct Instruction model*	*Rosenshine's Explicit Teaching model*
Introduction	1. Introduction of new concept based on previously mastered skills and knowledge	1. Review: Review homework Review relevant previous learning Review prerequisite skills and knowledge for the lesson
Main Presentation of the Lesson	2. Presentation: Fast-paced, scripted explanation or demonstration designed to elicit only one interpretation of concept. The target concept must be reinforced with appropriate examples and nonexamples.	2. Presentation: State lesson goals and/or provide outline Teach in small steps Model procedures Provide concrete positive and negative examples Use clear language Check for student understanding Avoid digressions
Practice	3. Students are provided with opportunities to verbally respond, either through a set of questions or tasks, in order to indicate their learning of the concept and their ability to connect it to further examples. 4. Feedback: Teacher either confirms correct student response or provides corrections and repetition of the missed items. 5. Independent practice: After group work, students engage in self-directed practice in workbooks. Teacher monitors progress and provides guidance when needed.	3. Guided practice: More time High frequency of questions or guided practice All students respond and receive feedback High success rate Continue practice until students are fluid 4. Corrections and feedback: Give process feedback when answers are correct but hesitant Give sustaining feedback, clues, or reteaching when answers are incorrect Reteach when necessary 5. Independent practice Students receive help during initial steps or overview Practice continues until students are automatic (where relevant) Teacher provides active supervision (where possible) Routines are used to give help to slower students 6. Weekly and monthly reviews

Table 1 ☐ *continued.*

Basic Direct Instruction	*Good & Grouw's Strategies for Effective Teaching model*	*Hunter's Design of Effective Lessons model*
Introduction	1. Daily review (first 8 minutes except Mondays): Review concepts and skills associated with the homework Collect and deal with homework assignments Ask several mental computation exercises	1. Anticipatory set: Provide a mental set that causes students to focus on what will be learned Use to glean diagnostic information about students' ability to connect with topic 2. Objective and purpose: Present objective to students to clearly communicate what they are supposed to learn from the lesson Present purpose to students so they know why the information is relevant to them
Main Presentation of the Lesson	2. Development (about 20 minutes): Briefly focus on prerequisite skills and concepts Focus on meaning and promoting student understanding using lively explanations, demonstrations, process explanations, illustrations, etc. Assess student comprehension using process/product questions (active interaction); using controlled practice Repeat and elaborate on the meaning portion as necessary	3. Input: Conduct a task analysis on final objective to determine the knowledge and skills that need to be acquired Use pedagogies that will facilitate the kinds of learning intended (e.g., discovery, discussion, reading, listening, lecture, observation) 4. Modeling: Demonstrate the processes and products that facilitate learning—these can be live or filmed, but must enable students to perceive directly what is to be learned
Practice	5. Seatwork (about 15 minutes): Provide uninterrupted successful practice Momentum—keep the ball rolling—get everyone involved, then sustain involvement Alerting—let students know their work will be checked at end of period Accountability—check the students' work 6. Homework assignment: Assign on a regular basis at the end of each math class except Fridays Should involve about 15 minutes of work to be done at home Should include one or two review problems 7. Special reviews Weekly review & maintenance: conduct during the first 20 minute each Monday, focus on skills and concepts covered during the previous week Monthly review & maintenance: conduct every fourth Monday, focus on skills and concepts covered since the last monthly review	5. Checking for understanding: Determine if the students understand what they are supposed to do in the lesson's task through questioning 6. Guided practice: Practice the new knowledge or skill under direct teacher supervision 7. Independent practice: Assigned only after teacher is reasonably sure that students will not make serious errors

integrated into practice in K–12 settings: (a) Rosenshine's (1979) explicit teaching model, Good and Grouws's (1979) strategies for effective teaching model, and Hunter's (1982) design of effective lessons model. In addition to representing DI models that are supported by sound research and practice, these models were selected for this chapter because they represent DI variations that were sensitive to contextual needs, discipline, and the changing landscape of educational theory and practice. Rosenshine's model was designed to be sensitive to differences in student ability and complexity of subject matter. Good and Grouws's model was designed for the teaching of mathematics. This model is included to illustrate how DI was modified for a particular subject matter context. Hunter's model was designed to incorporate the new cognitive principles, as well as to become more user-friendly for K–12 teachers with a closer alignment with well-established educational practices.

Rosenshine's explicit teaching model. The central theme in Rosenshine's (1979) and Rosenshine and Stevens's (1986) model is that teachers need to enact intentionally clear and well-defined lessons. The six functions of each lesson include (a) review, (b) presentation, (c) guided practice, (d) corrections and feedback, (e) independent practice, and (f) weekly and monthly reviews. The major instructional strategies include teaching in small steps with student practice after each step, guiding students during initial practice, and providing all students with a high level of successful practice. The specific steps of this teaching model are listed in Table 1.

Note the strong parallels between Engelmann's and Rosenshine's models. Both have a clear emphasis on frequent teacher-student interaction to present information, ask questions, guide practice, and provide feedback and reinforcement. Rosenshine, in extending the model, added guidelines to suit different students and difficult material. To meet student needs, Rosenshine suggested the teacher provide slower students with more review, less presentation, more guided practice, and more independent practice. For faster students, he suggested less review, more presentation, less guided practice, and less independent practice.

Rosenshine also brought attention to the need to modify lessons based on the material or content to be taught. His modification for difficult content emphasized additional monitoring, with the lesson cycle focused on presentation, guided practice, and supervised independent practice.

Good and Grouws's strategies for effective teaching model. Focusing on the teaching and learning of mathematics, Good and Grouws's (1979) research resulted in a scripted procedure that included both instructional and management strategies. While following the basic DI procedure, this model offered suggested lesson management strategies and time allotments for each phase of the lesson, including weekly and monthly practice intervals (see Table 1).

Although there are clear alignments with the aforementioned DI procedures, Good and Grouws's (1979) model began to emphasize the cognitive dimension of learning. In Table 1, note the focus on meaning and conceptual understanding of mathematics, along with the development of automaticity with computation and procedures. Good and Grouws's (1981) research indicated that teachers who used this model used more problem-solving procedures. Moreover, there were significant differences in favor of the students who were taught using this model in terms of problem-solving scores and gains in achievement.

Hunter's design of effective lessons model. Madeline Hunter became a "household name" in teacher professional development in the 1980s. She developed and disseminated a widely known and used teaching model that merged the well-engrained and more highly regarded features of DI with more current ideas and verbiage from cognitive psychology. Her lesson cycle model (Hunter, 1976; 1982) became the centerpiece of K–12 professional development and teacher evaluation programs because of its resonance with practitioners and ease of use for administrators who were conducting observational evaluations of teachers.

The Hunter model follows the basic DI procedure (see Table 1), however, she connects observable behavior with internal processing inferences. For example, her initial phase is called an "anticipatory set" and provides the introduction to the lesson by trying to connect with a "mental set" that the children already hold. When she explains the nuances of modeling, Hunter alerts teachers to pay attention to student perception and knowledge acquisition. Hunter's model represents a direct instructional model that was designed for practitioners who were trying to infuse the concepts and terminology used by cognitive psychologists into the existing strategies of earlier DI models.

Gagné's Events of Instruction Model

Robert Gagné (1977, 1985) made enormous contributions to the instructional theory literature. His work consistently merged current learning theory and instructional practice. His events of instruction model has provided instructional designers with a framework for creating instructional lessons in which every component speaks directly to empirically based principles of learning. Although the major components of Gagné's model fit the basic DI procedure (i.e., introduction, presentation, practice), the full model provides clear direction for lesson design and, more relevant for this discussion, the design of technology-enhanced or technology-driven instruction. However, whereas Gagné recommended following the sequence of events as published, Frieberg and Driscoll (2000) purported that the sequence could be modified based on the needs of the learner, context, and content.

Table 2 outlines Gagné's (1977, 1985) events organized according to the basic DI procedure, and elaborated with the learning processes and principles that his events support. It is for this reason that we separate Gagné's model from the

Table 2 ☐ Gagné's Events of Instruction model.

Basic Direct Instruction Procedure	*Events of Instruction*	*Connections with Learners and Instruction*	*Possible Connections with Design Features of Instructional Technology*
Introduction	1. Gaining attention 2. Informing the learner of the objective	Motivation phase: expectancy Apprehending phase: attention and selective perception	Attention gained through use of auditory and/or visual stimuli Presentation of information through appropriate media types
Main Presentation of the Lesson	3. Stimulating recall of prerequisite learning 4. Presenting the stimulus materials 5. Providing learner guidance	Acquisition phase: coding and storage entry Retention phase: memory storage	Prerequisite knowledge can be assessed through quizzing or assessment tools Information presented through appropriate media types
Practice	6. Eliciting the performance 7. Providing feedback with performance correctness 8. Assessing the performance 9. Enhancing retention and transfer	Recall phase: retrieval Generation phase: transfer Performance phase: responding Feedback phase: reinforcement	Guided practice can be teacher-led through telecommunications or self-paced through computer-based interactions. Corrective feedback can be provided, based on learners' responses Automated remediation can be designed into program Retention and reinforcement through application of new knowledge in scenarios through various media types

effective teaching models and highlight his work as foundational to the design of instructional technologies. His work reflects a blending of the behavioral and cognitive frameworks, and for these authors, serves as a bridge across perspectives on learning. Also in Table 2 are specific examples from instructional software or distance education course activities that support each event.

Expository Teaching

Expository teaching is a teacher-centered approach to learning content that parallels the goals and features of its predecessor, DI (Jacobsen et al., 1993), yet clearly is oriented toward cognitive- or information-processing–based learning. Rather than strengthening student behaviors, this model is designed to strengthen students' cognitive structures (Joyce et al., 2000). Ausubel (1968) is often cited as the originator of this model (e.g., Freiberg & Driscoll, 2000).

Expository teaching is used in order to help students learn concepts, principles, generalizations, and rules. Aligned with the DI tradition, the two major advantages of the model are time and control. Lesson objectives are clearly delineated, and questioning is convergent to ensure that the objectives are met. Examples are planned to ensure that students are gradually "scaffolded" toward the target concept, abstract relationship, or generalization that was articulated in the objective.

The teacher follows a sequence of steps that are designed to bring students closer and closer to defining the concept in terms that make sense to them (Eggen & Kauchak, 1993). Concepts are clarified through the development of definitions and connections with students' prior knowledge. Active participation is encouraged to ensure that the teacher can assess student progress. Students must provide their own examples to promote practice. Feedback is rendered immediately to ensure that misconceptions are not developed. Table 3 illustrates the components of expository teaching as they relate to DI.

Teaching as Assisted Performance

Research that emphasizes the social construction of knowledge has continued to include and elaborate on the contribution that DI makes to the creation of successful learning environments

Table 3 ☐ Current direct-instruction–related models.

Basic Direct Instruction Procedure	*Expository Teaching*	*Teaching as Assisted Performance*
Introduction	1. Visual presentation of targeted concept, abstraction, or generalization 2. Inform learner of intended learning outcome	Instruction
Main Presentation of the Lesson	3. Define concepts, abstractions, or generalizations 4. Link to prior knowledge 5. Provide positive and negative examples	Modeling Questioning Feeding-back Contingency management
Practice	6. Classify or explain teacher examples 7. Provide additional examples (Jacobson, Eggen, & Kauchak; 1993, 190–191)	Cognitive structuring Types 1 & 2 Feeding-back Questioning

(e.g., Tharp & Gallimore, 1988). The theoretical and empirical work of Vygotsky (1978) has identified two critical elements of DI as essential to learning from a social perspective (Eggen & Kauchak, 2001). Vygotsky's use of the notion of scaffolding and his construct of the zone of proximal development (ZPD) are instantiated in the teaching as assisted performance model (Tharp & Gallimore). Although the model expands beyond scaffolding and the ZPD[1], these concepts are addressed here to illustrate the important elaborations of DI into a new perspective on learning and teaching.

For Vygotsky (1978), *scaffolding* refers to the instructional support provided to students as they learn new skills, content, and dispositions. Information is broken down into manageable, smaller chunks of recognizable knowledge; skills are broken down to subskills to ensure a sequential, step-by-step acquisition of the target objectives aided by teacher guidance, questioning, hints, and so forth. Essential in this process is a task analysis that thoroughly examines what is to be learned, and the trajectory of the development of knowledge to meet that objective.

The ZPD is, according to Vygotsky (1978), the "distance between the actual developmental level as determined by individual problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Eggen and Kauchak (2001) asserted that the ZPD is "instructional paydirt" (p. 278) in that it is within this time, place, and space that teachers are most effective in helping students learn. From a DI perspective, teachers are striving to meet each student within the zone by a clear analysis of the task, constant assessment of understanding and provision of support when and as needed, and practice first with the teacher, then with peers, then independently. Tharp and Gallimore's (1988) notion of teaching as assisted performance makes explicit the need for teachers to directly plan and intervene with teacher-directed instruction based on student needs as evidenced in their practice. See Table 3 for the explicit connections between teaching as assisted performance and DI.

Summary

The DI model has enjoyed a more than 30-year history of framing successful learning experiences. The model has evolved to address current understandings about learners and learning, but maintains the central purpose of promoting student on-task behavior through explicit instruction, ongoing support, and student engagement in successful practice. The DI model is well suited to the design of technology-enhanced and technology-based instruction because of its clear structure and potential for providing learners with opportunities for practice and immediate feedback, especially in asynchronous learning environments.

TECHNOLOGICAL APPLICATIONS OF DI

DI continues to hold potential as an effective teaching method, particularly in technology-mediated learning environments. Computer-based programs have been designed to model instructor-led DI approaches while leveraging the technological ability to provide feedback, remediation, and guided practice, all essential components of the DI process and all of which contribute to its effectiveness. The following section provides examples of computer-based implementations of DI that demonstrate the particular advantages of technology to instantiate this model.

Successful Applications of Computer-Mediated DI

One of the first technology-based programs to implement the DI approach was developed by the originators of the DI method. Core Concepts, a reading, math, and language videodisc pro-

1 Tharp and Gallimore (1988) identified six components to their teaching model: (a) modeling, (b) contingency managing, (c) feeding back, (d) instructing, (e) questioning, and (f) cognitive structuring. Although all these teaching strategies have clear connections to DI, the two selected for this article are highlighted to illustrate how DI has transcended current theory on learning and emerged as a key model for the design of successful learning environments.

gram, was developed by the originators of the DI approach (Hofmeister, Engelmann, & Carnine, 1986, 1988). In this instructional program, brief segments with narration and animation were used to break down complex skills into small steps, model problem-solving strategies, present a wide range of examples, review relevant preskills, provide discrimination practice and cumulative review, and frequently assess student learning through weekly progress checks. Five experimental studies over seven years have demonstrated the program's effectiveness for low-achieving students. A naturalistic study found that the constant review was essential for low-achieving students, and the variety of activities within each lesson helped keep students interested and motivated (Adams & Engelmann, 1996).

Another basis for the creation of such programs is the teaching of complex skills or subjects, an example of which is a program designed to teach the solution of mathematical word problems (Steele & Steele, 1999). Project Discover is an intelligent tutoring system comprising 11 independent programs, based on the DI instructional approach. As students work through each program, the system collects information about their performance and makes recommendations regarding sequencing and practice options. In accordance with the DI model, the first program provides a pretest to assess their existing knowledge and an introduction to the process of solving word problems. The next three programs teach the eight steps involved in the solution of word problems, each aspect incorporating practice and corrective feedback. The next five programs provide practice opportunities particularly related to the eight steps, with problems automatically based on the steps that the learner finds problematic. The next program gives students in-depth practice, with incorrect responses being met with hints or coaching. Successful performance on this program (more than 90% correct) directs the learner to the posttest, less than 90% correct leading students to more practice based on their individual needs.

Merging Pedagogies Through Technology

Although viewed as an "instructive" design strategy (Rieber, 1992), DI can be combined with more open-ended strategies to provide dynamic and meaningful learning experiences (Fitzgerald & Semrau, 1998; Rieber; Sfondilias & Siegal, 1990). Fitzgerald and Semrau described The Classroom Behavior Record, a hypermedia program that implements DI methods for training educators and health care professionals in observational skills. While the use of hypermedia to engage students in DI may sound paradoxical, the program is based on the stages of learning model (Gagné, 1977) and facilitates learner progression through the hierarchical phases (acquisition, fluency, generalization, and maintenance) with the inherent flexibility of a nonlinear system. Rieber contended that constructivist and instructivist strategies are not mutually exclusive, and described how the two are integrated within a microworld program called Space Shuttle Commander, a computer-based learning environment modeled after the LOGO system (Papert, 1980).

Sfondilias and Siegal (1990) utilized a unique combination of DI and discovery methods in a computer-based program to teach learners the process to determine equations for parabolic graphs. Learners are guided through the cognitive routine for creating the correct equation, and then presented with an exploration situation in which they attempt to make their graph resemble a target graph, based on their inputs into the correlating equation. Feedback allows them to learn from their mistakes, and errors in the cognitive routine will prompt the system to repeat the routine until the learner has mastered it.

Recent Iterations of DI

The current emphasis on accountability and high-stakes testing in education has opened the door for commercial software products based on the DI model. Courseware packages such as SuccessMaker Enterprise by Pearson Digital Learning (http://nclb.pearsonedtech.com) and PLATO Learning (http://www.plato.com) claim to use DI methods to address student performance mandates of the No Child Left Behind (NCLB) Act. Both packages provide pre- and postassessment of learners with integrated practice and additional assessments throughout the instructional programs, designed to closely monitor student progress and customize the learning experience based on individual needs. While PLATO has evolved over the past 40 years from a large-scale mainframe program to a comprehensive courseware system for K–12 and adult education, it has maintained the aforementioned features that signify the DI approach to instruction.

The Future of DI

Recently, DI seems to have fallen out of favor in terms of philosophical trends of learning and instruction (Duffrin, 1996; Edmondson & Shannon, 2002). However, this model still serves as a viable and effective teaching approach in many classroom settings, and has been shown to increase students' problem-solving skills (Good & Grouws, 1981). Maintaining the tradition of being one of the most empirically tested forms of instruction, research on the DI model continues (i.e., Cashwell, Skinner, & Smith, 2001; Swanson, 2001; Viadero, 2002). In an effort to support the dissemination of such studies, the *Journal of Direct Instruction* was established in 2001 as a peer-reviewed forum to disseminate contemporary research regarding DI (Slocum & Marchand-Martella, 2001).

With the exponential growth of distance education, DI holds potential as a teaching method that can be effectively implemented on a wide scale in distributed learning environments, particularly through Web-based instruction. As previously described, computer-based instruction can efficiently execute all phases of the DI approach in an individualized and self-paced manner. However, networked systems can add increased flexibility in that instruction can be computer based, instructor led, or a combination of both. Asynchronous course template systems such as Blackboard or WebCT possess the ability to conduct preassessments of knowledge, present content information in a variety of formats, and provide varied levels and types of practice and postassessment with corrective feedback to customize the experience to the needs of the individual learner. Synchronous systems such as CentraOne allow for assessment of content knowledge prior to engagement in a live, audioconference with a teacher. In such a session, the instructor has the ability to present relevant information verbally, supported by a variety of visual tools, such as a shared whiteboard, text-based chat spaces, and software applications. Conferencing systems such as these also allow the teacher to conduct real-time questioning and provide appropriate feedback, addressing the human component often missing from asynchronous instruction. The tool's capacity to support asynchronous practice is based on quizzing and testing instruments designed by the instructor, which can also provide automated, corrective feedback. Features of the aforementioned types of Web-based systems can be blended to offer a hybrid approach to DI, in which some aspects are live and some asynchronous, depending on the needs and constraints of the participants.

DI will likely see the pendulum swing back to its favor in the near future, especially given federal and state mandates related to standards-based performance in schools. Advances in learning technologies are ready to support and implement this long-standing teaching method in more efficient and personalized ways. Standalone computer-based systems offer the flexibility of either supplementing DI in the classroom or providing entire self-contained units of instruction. Networked distance delivery systems supply the same possibilities to geographically dispersed learners, with the added ability of interacting with an instructor either synchronously or asynchronously. When the instructional task calls for the teaching of discrete skills and knowledge in an interactive and guided format, DI remains a proven approach. With the ability to exemplify the DI method through innovative, mediated experiences, instructional technology may hold the key to the continuing evolution of the DI method. □

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